The Air We Live In

The Health Effects of Air Pollution

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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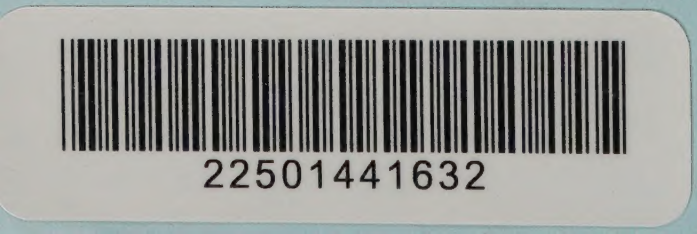

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Thousands of times on every day of our lives air passes through our nostrils into our lungs. We take in some 15,000 quarts of air per day, 10 times as much by weight as our intake of food and water combined. And yet, careful as we have learned to be of the purity of these other essential elements of living, we give little thought to the quality of the air we breathe.

Years ago, the air was wrongly blamed for many scourges of man. The word *malaria,* which is simply the Italian word for "bad air," still testifies to an accusation long since proved false. Early accounts of epidemics of everything from cholera to influenza are full of references to "noxious vapors" and "night airs." Then, with the advance of bacteriology in the 19th century, the possible health significance of air was all but forgotten in the great crusade for safe water, milk, and food.

The Air Over Our Cities

Today we are being forcibly reminded of the importance of the air we breathe. As our metropolitan areas grow larger year by year and our industries grow more diverse and complex, vast quantities of wastes of all kinds are thrown into the atmosphere above our cities. There they intermingle and interact chemically, catalyzed by sunlight.

And there, when the winds don't blow, they stay. Our millions of urban and suburban dwellers breathe in the complicated mixture. They have no choice. The purity of the air 20 miles outside the city or 5 miles above it is, for them, irrelevant and immaterial.

What harm does it do? We are just beginning to find the answers. We know that in extreme circumstances polluted air can kill. We know that it can make us cry, sneeze, and cough; can corrode our

buildings, splotch our laundry, and ruin our paint; can make our town a depressing place in which to live and work. We have reason to suspect that breathing polluted air may have long-term effects on our health, surpassing in importance anything we yet can prove.

The study of the health effects of air pollution is in its beginning stages. This booklet is intended to outline, in brief and in general, our present status of knowledge: What we know, what we suspect, and what roads of future investigation appear promising.

The Research Challenge

Thorough scientific investigation of the medical implications of community air pollution is very new; before World War II virtually nothing had been done, and very little before 1950. There was abundant evidence which suggested the possibility of health damage, but most of it was circumstantial—variations in the geographical distribution of deaths from various causes, proved cases of illness and death from occupational air poisoning, occasional disasters, and the like. What was needed, and in large measure is still needed, was a core of uncontrovertible facts relating polluted air to specific diseases and conditions.

Two Lines of Attack

Two principal lines of attack are being followed by the researchers in the field. The first is to apply methods which have worked so well in the control of communicable diseases: To study patterns of health and sickness in various communities, and to compare these patterns with air pollution measures and indices. The techniques employed are those of field investigation and statistical analysis.

The second avenue of research is to study the biological damage caused by certain known ingredients of community air supplies—singly and in combination, short-term and long-term, in high and low concentrations. Here the scene is the laboratory, and the techniques are observation and experimentation.

Thus, research into the health effects of air pollution applies well-established scientific methods to a

problem which is little understood and enormously complex. Considering the newness of the undertaking and the seemingly infinite number of variables involved; results thus far obtained under private, industrial, and governmental sponsorship are impressive, and promise well for the future.

Status of Knowledge

The impact of polluted air on our health appears to take two general forms.

The first is more dramatic, better known, and, fortunately, rarer—the acute "episode" resulting from a deadly combination of man-made pollution and protracted bad weather.

The second is subtler, harder to observe and document, and very little understood—the cumulative effect of breathing polluted air over a period of years.

A third type of effect, acute and temporary irritation of the eyes and other membranes, such as that produced by the notorious Los Angeles smog, appears to cause little or no long-range damage and therefore lies somewhere near the borderline between health effect and nuisance.

Air Pollution Episodes

In Belgium's Meuse Valley in 1915 and 1930, in Donora, Pa., in 1948, and in London in 1948, 1952, and 1956, the nuisance has turned killer. In each case, the immediate cause was a heavy fog which settled over the area and did not lift; in each case also, this phenomenon was produced by what meteorologists call a temperature inversion—a layer of heavy, cold air sitting on top of warm, moist air like the lid on a kettle. And in each case the death-dealing ingredients were smokes and fumes from homes and factories, mixing with the fog and building up to intolerable concentrations.

The Donora story is the most familiar to us, because it happened here. Twenty deaths were specifically attributed to the episode. Thousands of the city's residents were made ill, to a greater or lesser degree.

How many more deaths would have been recorded had the fog not lifted on the sixth day is anyone's guess.

But the London fog of December 1952 ranks as the leading disaster in air-pollution history. During one week, between 4,000 and 5,000 more people died in London than would normally have done so. Throughout the long annals of the city's vital statistics, only one other week showed so high a death rate—the week marking the crest of the influenza wave in 1918. Not even the cholera epidemics of the 19th century had so powerful an impact.

Ill Health for the Survivors

Both in Donora and in London, most of those who died were elderly people already suffering from diseases of the respiratory or circulatory systems. But there is scant comfort in this. Many young and healthy persons were made violently ill, and there is significant research evidence which indicates that people who have been acutely affected by an air-pollution episode are sick more often thereafter and die sooner than their neighbors.

Ten years have passed since Donora, without another episode in the United States. Ten more may go by before another occurs; on the other hand, a more severe disaster may strike next week, in any one of a thousand cities, large and small. The best preparation against an air-pollution episode is to remove as much pollution as possible from the air before the fog comes—to mend the roof while it isn't raining.

Long-Term Effects

The "urbanization" factor in death rates is well established and recognized. Mortality for a number of diseases, notably arteriosclerotic and other heart diseases and cancer of the stomach, esophagus, and lung, is markedly higher among city-dwellers than among rural people.

The causes underlying this fact of contemporary life are less clear. Increased tensions and the accelerated tempo of life in the city are often blamed, espe-

cially in connection with heart diseases. Air pollution is another logical suspect. Probably many factors interact to produce the known result.

We would expect that air pollution would do its principal damage to the respiratory system. Research in Great Britain has established beyond reasonable doubt that community air pollution is directly related to chronic bronchitis, a disease ranked third among causes of death in England and probably first among causes of work-days lost due to illness. For various reasons, chronic bronchitis is not regarded as an important cause of death in this country, although some evidence indicates that it is increasing here.

Lung Cancer and the Air

The striking rise of lung cancer as a cause of death in most of the industrialized parts of the world has focused intense public interest on the search for its cause. As is well known excessive cigarette smoking has been strongly implicated as a contributory factor.

Less widely publicized is the fact that mortality rates for lung cancer among urban dwellers are significantly higher than among strictly comparable rural groups, smoking habits notwithstanding. Statistical studies now under way show possible parallels between lung-cancer rates and air-pollution indices.

A number of pollutants found in community air supplies are known to produce cancer in experimental animals, and chemical analyses have revealed many other potential cancer-producing agents. Currently, solid particles taken out of the air in eight different cities are being tested for their ability to produce cancer in mice. Taken together, this admittedly fragmentary evidence points unmistakably to relationship between air pollution and lung cancer which demands further exploration and study.

Irritant Gases and Toxic Substances

Sulfur oxides in the air are known to make breathing more difficult, even in concentrations commonly found in some of our cities. Ozone, another irritant

gas which occurs in community air supplies, can cause scarring of lung tissue in animals and can produce pulmonary edema (excess water in lung tissue). Ingredients of Los Angeles smog which are suspected of being eye-irritating agents have proved highly damaging to experimental animals in various concentrations. These irritants are made more damaging by the presence in air of suspended solid or liquid particles (aerosols) to which they adhere.

Epidemiological and statistical studies show parallels between air pollution and mortality rates from cancer of the stomach and esophagus, similar to those from lung cancer. We know that a considerable amount of pollution from air is swallowed. Many of those who were ill during acute episodes reported severe gastro-intestinal symptoms. It seems likely, therefore, that the medical effects of air pollution are not confined to the respiratory and circulatory systems.

Adding up the evidence, it is abundantly clear that acute air pollution can cause death among the aged and infirm and serious illness in the general population. It has been established that air pollution is a primary contributor to at least one specific disease—chronic bronchitis in Great Britain. It is possible that irritants present in air cause changes in the tissues of the respiratory tract and hamper breathing. Still unproved but supported by accumulating evidence is the theory that air pollution contributes significantly to mortality rates of many of the "urban" diseases of contemporary society, including arteriosclerotic and other heart conditions, and cancer of the lung, trachea, stomach, and esophagus.

The Work Continues

The future of research into the medical effects of air pollution is both challenging and promising. In general, four broad areas of investigation seem to offer prospects of success.

First, the field investigations and statistical studies aimed at an understanding of air pollution's influence on the geographical distribution of disease and death will be continued and intensified. Important com-

munity health surveys are presently being carried out in California and at Nashville, Tenn. Morbidity and mortality data, weather information, and accumulating facts on air pollution levels are being analyzed and correlated.

Second, the associations between air pollution and the functions of the respiratory system will be systematically explored. Results already obtained with test animals must be related to human reactions. A machine to test lung functions under various conditions has recently been developed and should prove helpful.

Third, the associations between air pollution and the various cancers and heart conditions previously mentioned must be more fully explained. Preliminary findings justify the inclusion of air pollution as a research target in the vast national effort to understand and control heart disease and cancer, our two greatest remaining health problems.

Fourth, the biological impact of specific pollutants will be studied intensively. The variety and complexity of the raw material is staggering, but promising beginnings have been made. Knowledge gained in this area will be of the utmost importance in devising specific plans for the control of air pollution.

As our knowledge advances on all these fronts, the day will draw nearer when we can confidently safeguard the air we breathe.

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